Norway's 300 GW offshore wind opportunity

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Letter from the authors

We are witnessing climate records at an unprecedented pace. Even if 2023 is an outlier, it only confirms the alarming trend of human-induced global warming and underscores the urgency to phase out fossil fuels. The world needs enormous amounts of renewable energy, and a large share of that needs to come from offshore wind.

At the same time, the offshore wind industry is entering its first crisis. Costs are soaring, attempts are being made to renegotiate contracts, and projects are canceled. Critics have wind in their sails, and within the public debate there is a negative sentiment around the viability and cost of offshore wind development.

Amid all this, Norway has started its offshore wind journey. It was a late start, and timing might seem unfortunate, but the industry is mobilized and energized.

In this report, we bring forward six key messages, each detailed in separate chapters:

1. **Europe needs all the wind power it can get.** Most of this needs to come from floating offshore wind in areas beyond current development hotspots.
2. **Norway is uniquely positioned for offshore wind.** There is potential to supply Europe with large amounts of secure, affordable, and clean energy, as well as to export pioneering floating wind solutions and technology.
3. **The government should set a stretch target of 300 GW.** Europe needs the energy. It will be good business for Norway, and it will make the first 30 GW cheaper.
4. **This will be the largest industrial shift since the 1970s.** New supply chains, a high-capacity offshore grid, and floating wind factories along the coast are needed to deliver on the ambition.
5. **Floating wind in Norway will be competitive by 2040.** Double-digit learning rates will lead to a levelized cost of energy of less than 45 €/MWh by 2040 for floating wind. Projects awarded at the end of this decade will be subsidy-free and profitable for developers, and the industry development will have a positive NPV of 600 billion NOK for the Norwegian state.
6. **Becoming a leader in floating offshore wind requires action now.** The socioeconomic upside is significant, providing 150,000 jobs, 870 billion NOK annual energy export revenue generated, and 400 million tons of annual CO_2 equivalents abated. However, there is no time to lose, and both the government and the industry must act now.

Norway is facing a unique opportunity that could equal the oil and gas industry development that started half a century ago. Not only can Norway meet its own climate target and support Europe in achieving theirs, but it can also continue its role as a vital partner for Europe, providing secure, affordable, and clean energy (electricity and green molecules). Income and jobs can be secured for future generations, particularly in coastal communities. With appropriate mechanisms, the power price can be stabilized at a consistently lower level, benefitting consumers and new industries alike. All of this can happen while maintaining minimal impact to nature.

This should be a winning formula for politicians from any party, but it takes courage and requires swift action. If we wait, other countries will take the lead and leave the Norwegian supply chain behind. Our call to decision-makers is to be bold and act fast. Prioritize long-term climate, nature, and economic benefits over short-term public opinion. Norway is at the doorstep of a unique opportunity. We have one chance—let's take it.

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1 | Europe needs all the wind power it can get

Large-scale renewables can meet Europe's energy needs

In 2019, the European Commission set a bold decarbonization target: net zero by 2050 and a 55% emission cut by 2030 compared to 1990 levels. However, projections indicate only a 60% reduction by 2050 at the current pace.

To achieve these targets, Europe's energy mix must fundamentally change from mainly fossil fuels today to primarily renewable energy in 2050 (see Exhibit 1). Electrification of transport, heating, and industry, together with hydrogen production, will be the key drivers of emission reductions, and lead to increased demand for green electricity production.

Russia's invasion of Ukraine and the Nord Stream attacks have demonstrated how vulnerable our energy system is. Energy security is top of mind for politicians, and the additional renewable generation capacity must be built in Europe. With the right approach and scale, the renewable expansion can solve Europe's energy trilemma and ensure secure, affordable, and clean energy for the future.

Wind's pivotal role in the energy transition

Several sources of renewable energy are needed to enable the decarbonization of Europe. Wind and solar will be the most important technologies, with a tenfold increase in installed capacity in 2050 compared to current levels.

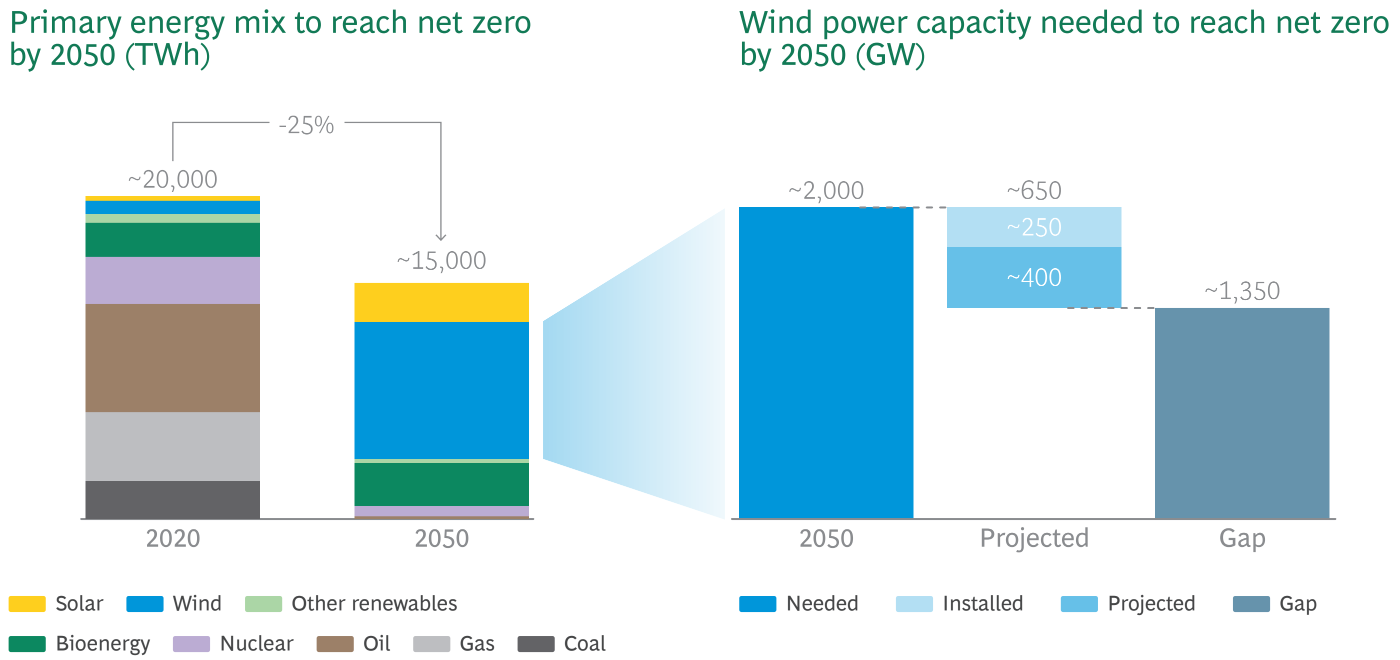
Wind power will likely constitute around half of the installed capacity, translating to 2,000 GW to reach the net zero commitment. This estimate is in line with that of WindEurope with a somewhat higher projection for green hydrogen production.

Today, Europe has 225 GW installed capacity of onshore wind and 30 GW of offshore wind. Under the current policy, an additional 400 GW of wind power is expected to be installed by 2050. Nine North Sea countries are taking the lead by committing to a combined total offshore wind capacity of 120 GW by 2030 and 300 GW by 2050 through the Ostend Declaration.

However, there is still a substantial gap of 1,350 GW to be closed, most of which must be filled by offshore wind given acreage limitations and public resistance to onshore wind and solar. Europe needs to look to countries and sea areas with the necessary conditions, space, energy infrastructure, and know-how to develop and house the additional 1,350 GW.

Potential areas for offshore wind can be found in many sea areas in Europe. Of these, the Norwegian coastal areas in the North Sea, Norwegian Sea, and Barents Sea have extraordinary properties, such as large available areas with suitable water depths and abundant wind resources. These areas have great potential for floating offshore wind.

Exhibit 1 | 2,000 GW wind capacity is needed by 2050 to satisfy Europe's net zero commitment with a 1,350 GW installation gap



Source: BloombergNEF; Enerdata Global Energy & CO_2 database; BCG analysis

2 | Norway is uniquely positioned for offshore wind

Norway is well positioned to take the lead in large-scale offshore wind, with exceptional wind resources, a strong supplier network, ample capital, and ability to mitigate potential downsides.

The best wind resources and abundant suitable areas for wind

One of the world's best wind resources: The Norwegian coastal areas rank among the world's finest locations for floating offshore wind. First, the wind blows often and strongly. Second, the vast geographical area allows for significant spacing between wind turbines and between wind farms, minimizing negative wake effects. The resulting capacity factors of 50–60% make a compelling business case, as the cost per MWh produced is low. Third, winds in the north are largely uncorrelated with those in continental Europe, making the production more valuable since it can meet European demand when the wind does not blow on the continent.

Abundant space for wind: Norway has one of the longest coastlines in the world, and the Norwegian economic zone and territorial waters sprawl across more than 850,000 square kilometers (excluding areas related to Svalbard and Jan Mayen). The Norwegian Water Resources and Energy Directorate (NVE) has identified low-conflict areas with the potential to host between 200 and 400 GW of offshore wind along the Norwegian coast (see Exhibit 2). The suggested areas occupy merely 6% of the Norwegian waters, leaving 94% untouched. Thus, it is possible to facilitate harmonic co-existence with fisheries, maritime traffic, and other affected stakeholders while ensuring that nature and the environment are properly safeguarded. This is aligned with Multiconsult's estimate of up to 338 GW offshore wind potential in low-conflict areas.

The fjords are ideally suited for floating wind factories: Deep-water quays in calm waters are needed to manufacture floating foundations. Once assembled, they need storage until suitable weather permits offshore towing and installation. Norwegian fjords are uniquely suited to meet these needs, offering both deep-water quays and ample storage. In addition, local availability of limestone for concrete foundations reduces the environmental footprint and transportation cost.

A well-established supplier industry to scale offshore wind

Supplier industry: Norway has access to offshore expertise from the oil and gas industry that can be leveraged across the entire process, from planning to building and operating offshore wind facilities. This includes manufacturing floating foundations, supplying installation vessels and installation capabilities, developing mooring systems, and offering maintenance and services in harsh offshore environments.

Facilities, workforce, and innovation: Norway's existing shipyards, oil and gas yards and facilities, and coastal infrastructure can be repurposed to accommodate the offshore wind factories needed to scale the industry. The workforce has extensive experience in offshore environments, and Norway is home to world-leading maritime research communities with robust industry ties.

Access to capital to jump-start the industry

Initial investment capital: The Norwegian government's significant financial power can be leveraged to establish the offshore wind industry. Subsidies and effective policies are needed to incentivize development of the local supply chain and attract international competence and capital to invest heavily in Norway. The task is to invest enough to ensure that Norway takes a world-leading position in floating offshore wind, yet not so much that Norway finances the entire cost reduction on behalf of the global industry.

Proven model for infrastructure: The state-owned gas infrastructure operator in Norway, Gassco, is a well-proven model for infrastructure that could be applied to offshore wind as well. A state-owned operator or coordinator of the offshore transmission grid can distribute the infrastructure cost across a wide number of projects to ensure equitable and fair access for all developers. It can more efficiently monitor and safeguard the cables. It will reduce project risk for developers will lower the cost of project development.

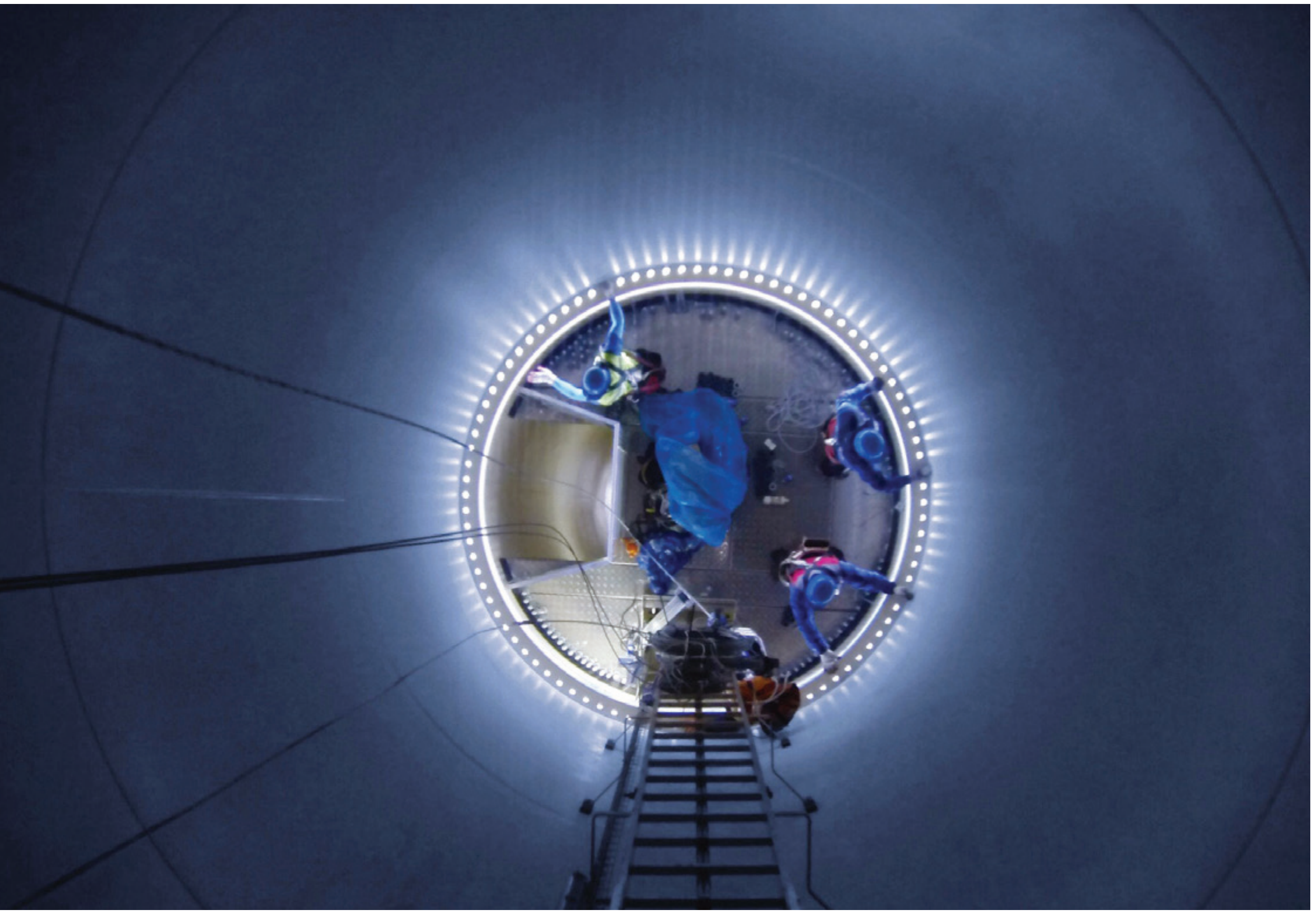
Norway can manage and mitigate potential downsides of offshore wind

To mitigate and manage environmental impacts, Norway should follow strict environmental standards for offshore wind manufacturing and installation. This will not only minimize direct local impact on marine ecosystems but also stimulate innovation and environmental solutions with potential global applications.

Floating wind is less invasive than traditional bottom-fixed offshore wind developments. It avoids intrusive seabed piling, can give marine life shelter and improve habitats, and simplifies the decommissioning process.

Exhibit 2 | 300 GW of offshore wind possible in the areas suggested by the Norwegian Water Resources and Energy Directorate (NVE)

Source: Norwegian Water Resources and Energy Directorate (NVE)



3 | The government should set a stretch target of 300 GW

300 GW should be Norway's stretch target

Europe requires an additional 1,350 GW of wind power to reach net zero by 2050. Given Norway's prime positioning for floating offshore wind, we believe Norway should set a stretch target of 300 GW by 2050, with clear interim targets for 2030 and 2040.

The rationale behind a stretch target of 300 GW has several main components. NVE and Multiconsult have indicated that there is space for approximately 300 GW in low-conflict areas. Genuine commitment to offshore wind in Norway will help alleviate the current supply chain crisis. A substantially higher target than 30 GW is necessary to establish a new industry with a local value chain. An ambitious buildout of 300 GW will bring large social and economic benefits to Norway. And finally, replacing oil and gas with electrical power and derivative molecules from offshore wind will ensure that Norway can remain one of Europe's key energy partners.

Supply chain investments: A binding target and transparent roadmap for building substantially more offshore wind in Norway will help alleviate the supply crisis. Developers who are currently reevaluating their presence in Norway will commit fully to building a position and investing in the local supply chain. Suppliers who are currently struggling will be able to convince their owners to commit capital to investing in production facilities that can reduce bottlenecks.

New industry: A firm commitment to the offshore wind industry will catalyze investments in Norway's offshore wind value chain and nurture the emergence of locally developed technologies with the potential for export. Menon Economics projects that 40 GW of floating wind could generate 50,000 new direct and indirect jobs in Norway by 2050. On this basis, we estimate that a 300 GW ambition could provide 150,000 jobs when factoring in anticipated efficiency improvements. This represents 75% of the workforce employed in Norway's oil and gas sector as of 2022 and would therefore be more than enough to employ the oil and gas professionals who will need new jobs in the coming decades..

Export revenues: Annual export revenues are projected to reach 870 billion NOK with 300 GW in operation. This figure is conservative, considering only the direct revenue from energy export. A local offshore wind industry will also lead to significant export of technology and capabilities to the rest of the world. Floating offshore wind is still a nascent industry, and Norway can take a leading role in developing the technology and solutions needed.

Energy partner for Europe: In 2021, Europe imported 55% of its consumed energy according to Eurostat. By 2050, Europe's need for renewable energy is expected to soar to 10 times today's demand. The energy export from 300 GW of offshore wind is similar in terms of energy amount to the anticipated reduction in oil and gas export from Norway by 2050. By amplifying its offshore wind efforts, Norway can remain one of Europe's key energy providers and solve Europe's energy trilemma by providing secure, affordable, and clean energy.

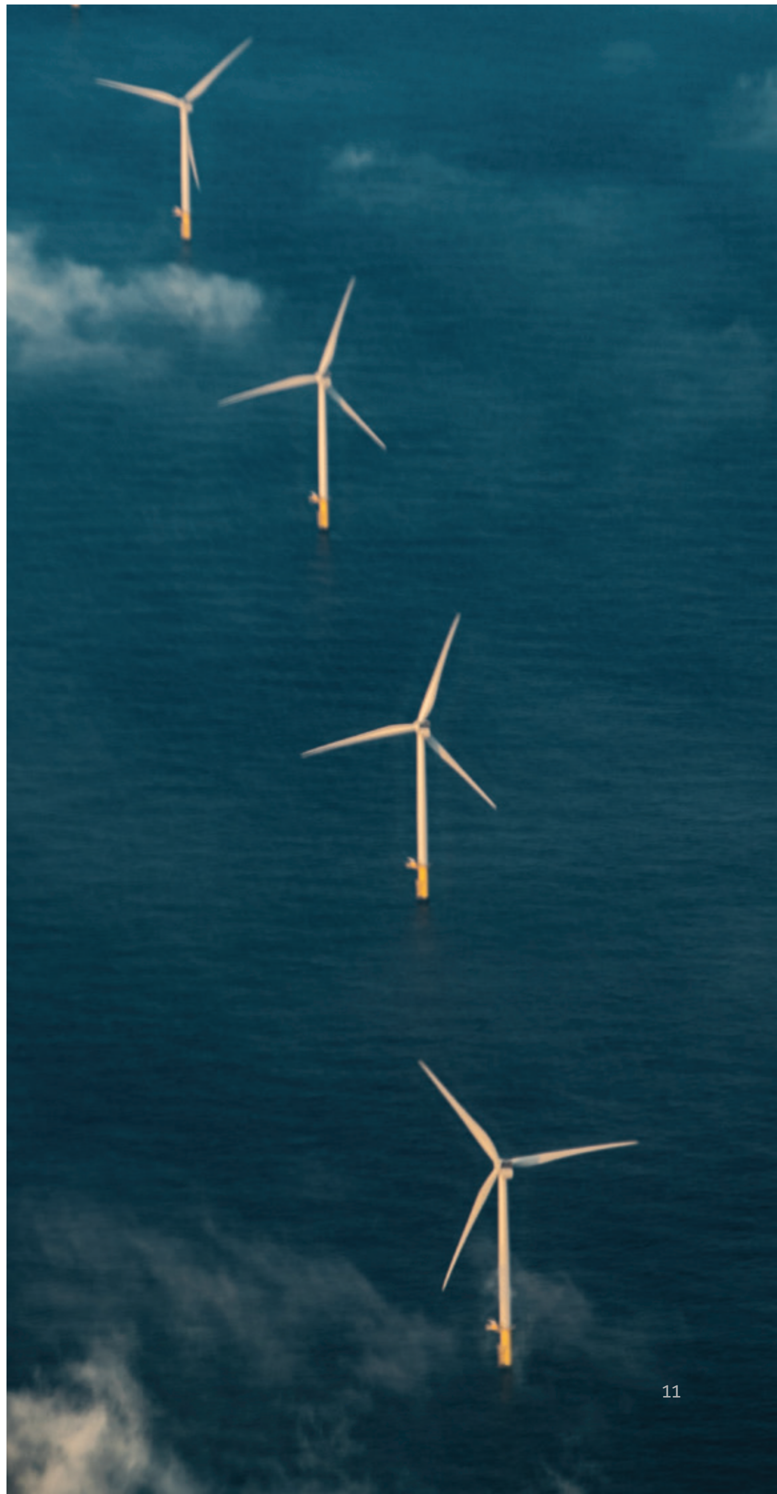
While we view 300 GW as an optimal target for Norway, both in terms of supply chain capacity and sea area availability, noteworthy benefits can still be realized at lower levels, such as 200 GW.

Subsidies are needed for the first projects

An investment of 115 billion NOK in subsidies will be needed to make the first floating wind projects profitable for developers. The subsidies are not a financial hindrance for Norway, as they correspond to only ~0.3% of Norway's national budget each year that subsidies are paid out. Moreover, the subsidy requirement could be reduced by mandating (and at the same time incentivizing through effective policies) the oil and gas operators to decarbonize operations with power produced by offshore wind. The recent decision to approve electrification of the Melkøya LNG plant highlights a missed opportunity for promoting offshore wind. The region needs additional power, and several developers have announced plans for offshore wind to electrify Melkøya. Mandating offshore wind to provide the additional power could have kick-started the offshore wind industry in the north.

By the end of this decade, developers are expected to see profitable business cases, eliminating the need for further subsidies. And as the industry evolves and costs are reduced, developers will likely be willing to pay concession fees for sites rather than seek subsidies.

The first 30 GW of offshore wind are needed in Norway to meet the domestic demand for electricity. In a 30-GW scenario (the government's current target), the subsidy need will be substantially higher than in a scenario where 300 GW is the target. This is because 30 GW will not provide the necessary scale, learning, or standardization to significantly reduce the levelized cost of energy (LCOE) of Norwegian floating wind.



4 | This will be the largest industrial shift since the 1970s

The largest industrial shift since the 1970s

Scaling the floating offshore wind industry and reaching 300 GW of installed capacity by 2050 will undeniably be an ambitious industry endeavor. To achieve this, we need to install an ambitious 15–17 GW of capacity annually from 2040 onward. This translates to producing 15–20 foundations every week throughout the year and installing 35–40 turbines each week during suitable weather windows (see Exhibit 3). The manufacturing and installation will involve thousands of skilled workers.

While it is a daunting task, Norway can take comfort in knowing it has done it before. Despite initial inexperience in offshore oil and gas development, Norway leveraged its robust maritime heritage in the 1970s to successfully build its own oil and gas industry. The industry developed at a rapid pace, with annual production scaling by more than five times between 1975 and 1980 and twenty times over the 25-year period from 1975 to 2000 according to the Norwegian Petroleum Directorate.

Now is the time to invest in a similar industrial shift. With the experience and infrastructure in place, Norway is even better positioned for success now than during the onset of the oil and gas industry in the 1970s.

Assembly-line offshore wind factories

Offshore wind is a business where mass-produced, standardized turbines and foundations are core to success. Similar to the auto industry's efficient assembly-line production, offshore wind can benefit from an approach that achieves the necessary manufacturing pace and cost reductions. Norway's geography is ideal to drive this transformative shift by establishing the first *offshore wind factories* in its fjords.

An *offshore wind factory* takes an assembly-line approach spanning from foundation construction to turbine assembly (see Exhibit 4). By parallelization, streamlining, and allocating specialists to specific tasks at each station, the assembly-line approach significantly enhances efficiency and accelerates the learning curve.

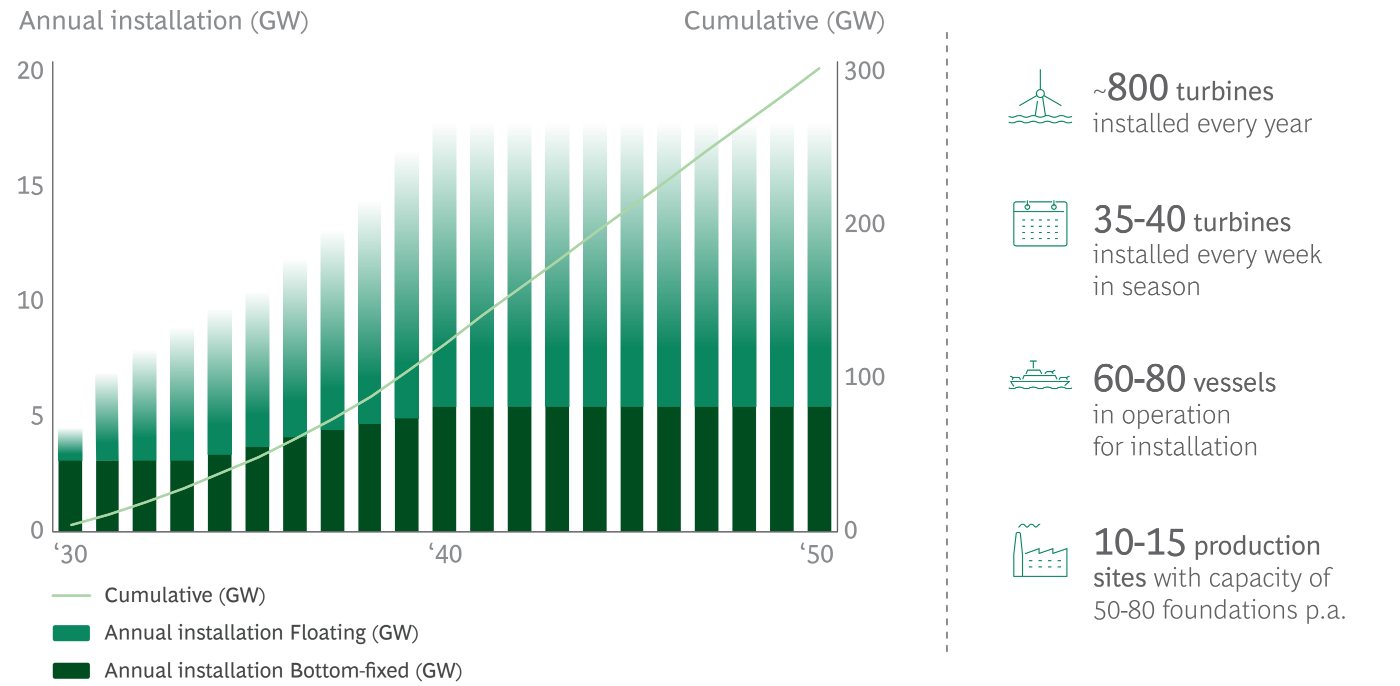
Foundations: 10–15 foundation manufacturing sites are required to produce an average of 15–20 foundations per week in 2040. Whether made from steel or concrete, the foundations are equivalent in size to multi-story buildings and require deep-water quays in calm waters for construction. The foundation components are put together or cast first on land, then quayside. Local sources of limestone for concrete foundations can reduce the environmental impact and cost of transportation.

Turbines: There are no wind turbine factories in Norway today. However, with an annual demand of 800 turbines from 2040 onward, there is a compelling case for turbine manufacturers to establish local turbine factories. Local production will reduce transportation challenges for large components and the carbon footprint, while also increasing the resilience of the supply chain. To keep costs down and learning rates high, the turbines should, to the extent possible, be standardized in terms of type and size across projects.

Assembly process: Foundations progress through the factory for installation of the tower, nacelle, and blades, avoiding the need for expensive heavy-lifting at sea needed for bottom-fixed wind. Assembled turbines require storage until the weather permits offshore towing and installation—also here, the fjords naturally offer the temporary deep-water storage space needed.

Offshore installation: Installation will involve the operation of 60–80 vessels (tugboats, anchor handlers, subsea support vessels, cable layers, etc.). During suitable weather windows, vessels will operate all day long to lay cables, install mooring, connect the turbines and electrical cables, etc. Repurposing of existing vessels and leveraging the strong maritime experience as well as Norwegian innovations in low-carbon shipping are key in this part of the value chain.

Exhibit 3 | Reaching 300 GW offshore wind by 2050 requires an efficient factory capable of producing ~800 turbines per year



Source: BCG analysis

Fit-for-purpose off- and onshore grids and alternative offtake

300 GW of offshore wind represents a tenfold increase in Norway's electricity generation. This will require extensive investments in the grid infrastructure onshore and offshore. Multiple new export cables are needed and the transmission system onshore needs to be strengthened significantly.

Building and operating the offshore grid is a massive undertaking. To ensure optimization for the entire Norwegian offshore wind portfolio and Norway as a whole, the Norwegian offshore grid could be developed, owned, and operated by the state through a similar vehicle to Gassco.

Furthermore, alternative offtake and export routes are needed. Hydrogen and ammonia will be important energy carriers in the future, and production of these can serve as alternative offtakes to grid export—for example, in times of low electricity demand or for direct industrial purposes. A regulatory framework for production and export of these carriers needs to be established and considered when designing the off- and onshore grid.

Risks related to offshore wind and how to mitigate

As a front-runner, Norway should ensure collaboration and knowledge sharing to avoid bearing the cost of technology development alone. Norway must also be aware of the inherent risks and uncertainties related to building a new industry:

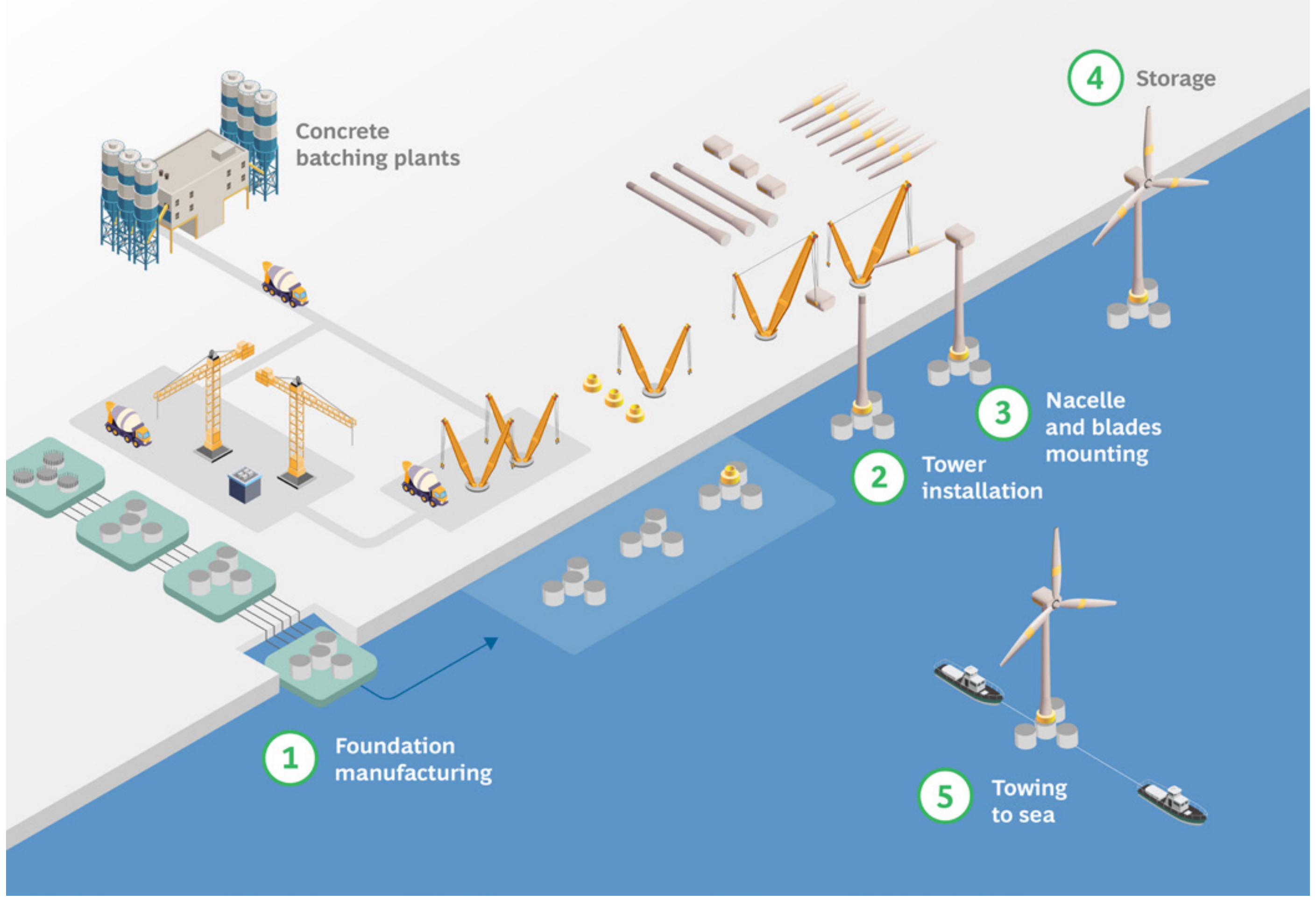
Regulatory ambiguity: Vague directives, slow processes, and unpredictable regulatory and tax policies will lead to delays and reduce investment appetite. Recent events, such as the postponed application deadlines for Utsira Nord and Sørlige Nordsjø II, the absence of Contract for Difference regulations in the same auctions, and the sudden imposition of a resource rent tax with retroactive effects on onshore wind are good examples of what should be avoided. The first auction round will help build offshore wind experience among the authorities, and we expect improvements in this area going forward.

Low power prices: Power price predictions carry inherent uncertainty. There are diverging views in the industry currently, with some believing in abundant power production and lower prices and others seeing a pan-European scarcity of green power and consistently higher prices as a result. Emerging technologies with significantly lower LCOE may lead to substantially lower power prices. Developers need to mitigate the power price risk in their business cases, looking for opportunities to secure offtake and increase value of the power through such levers as trading and downstream integration.

Supply chain squeeze: The offshore wind industry is currently facing its first crisis. Supply chains are severely challenged, as reflected by current cost increases, project delays and cancellations, contract renegotiations, and industry exits. There will be significant bottlenecks in the coming years, especially for turbines, foundations, installation vessels, and skilled labor. Suppliers are advocating for a more equitable distribution of margins, potentially leading to long-term elevated cost levels. Developers must prepare for more open-book collaboration with the supply chain and be prepared to invest in suppliers to distribute margins more fairly.

Insufficient absorption capacity: Delivering power (and derivates) to Europe from 300 GW of offshore wind will require major investments in grid infrastructure and power-to-X facilities. Norway is dependent on other nations to invest in their infrastructure to avoid stranded power. Continued collaboration at the state level will be required and a firm commitment to the stretch target will help create the environment for collaboration.

Exhibit 4 | The assembly-line floating wind factory increases speed and lowers cost of offshore wind



5 | Floating wind in Norway will be competitive by 2040

Floating wind will match the cost of bottom-fixed by 2040

From 2011 to 2021, the LCOE for bottom-fixed offshore wind saw a remarkable decline, going from 170 €/MWh to 70 €/MWh (International Renewable Energy Agency). In fact, since the 2000s, for each time the installed capacity of offshore wind has doubled, there has been a 30% reduction in cost. This learning rate has exceeded even the most optimistic analyst projections, and offshore wind has transitioned from being subsidy-dependent to generating substantial revenue to European governments in just the span of a decade.

Levelized cost of energy (LCOE) is a measure for comparing the cost of energy from different sources. It is the average net present cost per unit of energy produced over the generator's lifetime.

Floating wind is a far less mature industry, with only 200 MW installed capacity worldwide compared to 60 GW for bottom-fixed offshore wind. It will not experience the same learning rate as bottom-fixed since a significant share of LCOE improvements has come from increasing turbine sizes which will also benefit floating wind. That said, we expect double-digit learning rates for floating wind too.

We project that LCOE will drop from above 120 €/MWh in 2023, to less than 45 €/MWh by 2040 (see Exhibit 5). Our analysis is based on the following comparison of the two technologies.

Starting with the external differences, we see that floating wind has attractive attributes:

- *Better wind conditions:* Floating wind can be built in larger parts of the seas than bottom-fixed since it is not tethered to specific seabed conditions and has a higher maximum water depth. This flexibility unlocks access to prime sites with exceptional wind conditions, and minimal wake effects, culminating in higher average production.

- *Larger scale:* Fewer constraints on areas allow for larger wind farms. Multi-gigawatt wind farms enable further process standardization and efficiency in installation and operations and maintenance. Consequently, each project profits from amplified scale benefits.

- *Lower environmental impact:* Floating wind installations are usually situated farther offshore and utilize mooring that is less invasive than bottom-fixed structures. This minimizes the impact on local communities and marine ecosystems, likely leading to increased public support and reduced costs for environmental precautions.

Looking next at the technical components, we see that floating wind could match the cost of bottom-fixed wind:

- *Turbines:* The turbines used in floating and bottom-fixed wind are largely similar, although towers for floating turbines are designed to withstand higher loads with slightly higher material cost as a result.

- *Foundations:* At present, floating foundations constitute 20–30% of floating wind cost, compared to less than 10% for bottom-fixed designs. However, floating foundations have superior potential for standardization over bottom-fixed, which must be tailored to specific seabed conditions. In addition, floating foundations are simpler and potentially less material-intensive, especially compared with deep-water bottom-fixed counterparts.

- *Substation and cables:* Floating wind requires dynamic cables that are more costly than the ones used for bottom-fixed. However, considerable effort is currently being put in to improve the design, and the cost gap will narrow. Substations in deeper waters are also currently more expensive, but floating technology (or subsea technology) from the oil and gas industry will lead to a narrowing cost gap here too. Similar to the turbine foundations, the substation foundations can be standardized and less material-intensive compared to deep-water bottom-fixed counterparts. In addition, the substations can benefit from larger scale in floating wind by linking multiple parks to a few substations.

- *Mooring:* Although mooring presents an additional expense for floating wind compared to bottom-fixed, it is projected that costs will decline considerably with increased standardization and scale.

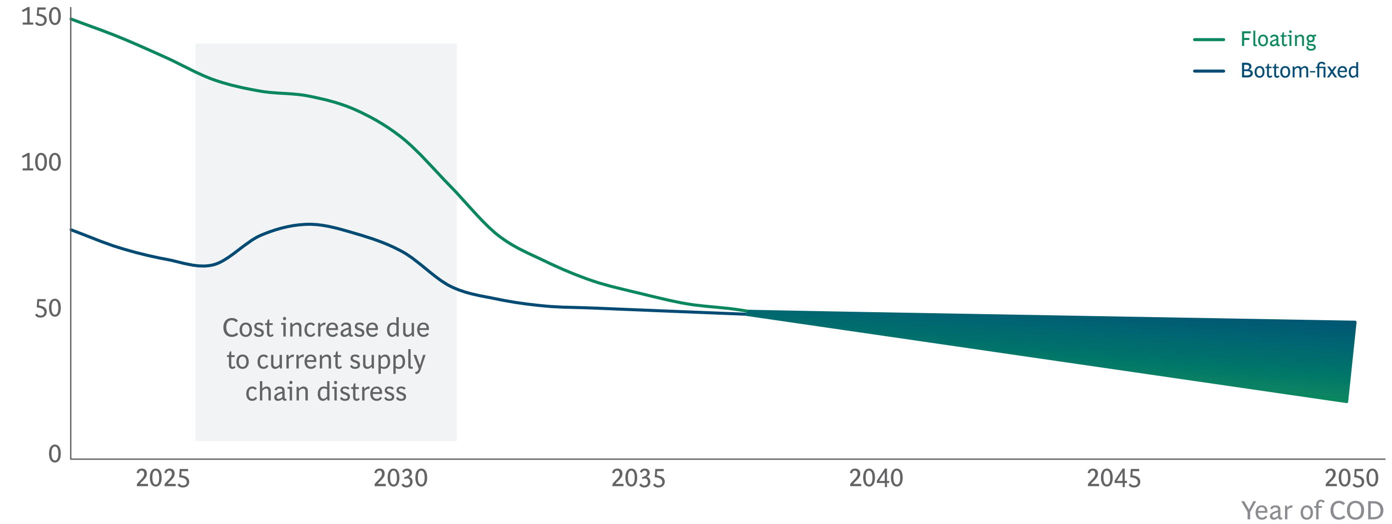
Finally, comparing the processes for installation and operations and maintenance, floating wind has clear advantages compared to bottom-fixed:

- *Simpler installation process:* Floating wind turbines can be entirely pre-assembled at the quayside, then towed and connected to pre-installed mooring systems at the wind farm. This eliminates the need for expensive specialized vessels required for the installation of bottom-fixed offshore wind.

- *Simpler large-part maintenance:* Maintenance and repair of large spare parts for floating offshore wind can likely be done by towing entire turbines to the shore, avoiding the need for costly specialized vessels.

Exhibit 5 | Floating wind likely to be cost-competitive by 2040

Anticipated LCOE development of large-scale floating wind versus bottom-fixed (€/MWh)



Source: Wind Europe; Wood Mackenzie; BCG analysis

LCOE projections prove that floating wind will be profitable

Based on the advantages laid out above, floating wind can achieve similar or even superior learning rates compared to the 30% rate seen for bottom-fixed wind. The only exception is the turbines, which will follow a similar learning rate as for bottom-fixed. If built out at sufficient scale, this means that floating offshore wind will reach cost parity with bottom-fixed by 2040.

Our conservative projections suggest a floating wind LCOE below 45 €/MWh by 2040. This assumes an 11.5% CAPEX learning rate based on figures from the U.S. Department of Energy's National Renewable Energy Laboratory (NREL) and a projected annual OPEX decrease from 50,000 €/MW in 2023 to 20,000 €/MW in 2040. We have applied a 7% discount rate, in line with NVE's standards. Even lower LCOE levels are achievable, and assuming, for example, a CAPEX learning rate of 15% instead of 11.5%, results in an LCOE below 40 €/MWh by 2040.

We have used forecasts of the European power prices from leading analyst firms. When combining these with our LCOE projection, we see that developers can anticipate new floating offshore wind farms to be profitable by the mid-2030s (commissioning date). In other words, floating offshore wind projects will have positive business cases and no need for subsidies already by the license rounds at the end of this decade.

We have also assessed the attractiveness of the industry build for the Norwegian state. We find a positive NPV to the state of 600 billion NOK when considering required subsidies and future taxes paid by developers. This assumes a perfect market design where developers achieve their required rate of return, and the state captures the remaining value. Such a value distribution can typically be achieved when developers compete for sites through monetary auctions. In practice, it can also be achieved through a combination of lease fees, company tax and other taxes.

Our conclusion depends on a firm commitment to scale the floating offshore wind industry quickly (including securing subsidies for the first projects) and on the power price development. However, we see a strong rationale for the Norwegian government to significantly increase the target for offshore wind in any scenario. Our sensitivity analysis (see Exhibit 6) indicates an attractive business case for the state across most power prices and floating wind LCOE-developments, with the value of future tax income exceeding required subsidies to developers. This conservative assessment only includes direct income to the state from developers, not the secondary economic and social benefits resulting from building a new industry providing 150,000 jobs. This means that even in scenarios where the standalone business case for offshore wind development is negative for the state, there will be profound and lasting positive ripple effects in society.

Exhibit 6 | The offshore wind business case is attractive to Norway

NPV to the state of subsidies and taxes from 300 GW offshore wind

Included in the calculations

- Taxes and fees collected from offshore wind developers
- Subsidies to developers required to make floating wind competitive

Not included in the calculations

- Income tax from employees in the offshore wind industry
- Social and economic ripple effects in society as result of providing 150,000 jobs
- Tax revenues from companies in other parts of the value chain
- Tax revenue from export of floating wind technology and solutions

Source: BCG analysis

6 | Becoming a leader in floating wind requires action now

This is an opportunity Norway cannot afford to miss

Norway's current target of 30 GW by 2040 is a good start and will be sufficient to supply the power needed for decades to come. However, Norway is at the doorstep of a unique opportunity that can shape the future. Anything beyond 30 GW represents a chance to export power and technology. Achieving the stretch target of 300 GW will yield 870 billion NOK in annual export revenues, provide 150,000 jobs, finance the welfare system for future generations, abate 400 million tons of annual CO_2 equivalents, and maintain Norway as one of the most important energy providers to Europe.

With the government's current 30-GW target, Norway risks falling behind rather than taking the lead in offshore wind. Large capital will be allocated elsewhere, value chains will be built elsewhere, and leading technology development will happen elsewhere. Once the country falls behind, catching up will likely become unattainable, as investments are substantial and favor others. 30 GW will create positive ripple effects in the supplier industry, but not nearly at the level they could have been at.

Norway has a one-time opportunity to establish itself as the leading offshore wind nation and get a substantial socioeconomic upside. However, to achieve this goal, Norway must attract large capital and leading offshore wind competence and expertise. This can only be done if the decisions-makers dare to make *bold* commitments *now*.

Actions for the government

- *Commit to 300 GW now:* Set a stretch target of 300 GW and create a transparent pipeline of auctions year by year to provide the industry with certainty to make significant investments. This will help address the current profit distribution and capacity bottleneck challenges in the supply chain too. Tender GW-sized areas instead of MW-sized areas to allow the necessary scale to enable profitable business cases for each wind farm.
- *Provide sufficient subsidies:* Ensure adequate subsidies are available for initial floating wind projects. Award the subsidies transparently as two-sided Contracts for Difference to minimize risk for developers and build in mechanisms to ensure that operators are incentivized to optimize production toward what serves the power market best.
- *Develop the grid and offtake:* Establish a state-owned entity to develop, own, and operate the offshore grid, including multiple new export cables. Provide sufficient funding and mandate to Statnett to upgrade the onshore grid. Coordinate with European transmission system operators to build a North Sea grid, including energy islands and power-to-X facilities.
- *Ensure regulatory clarity:* Establish and maintain transparent and stable regulations and safety standards to minimize uncertainties for developers and suppliers. Accelerate the approval and permitting process.
- *Encourage collaboration with industry and academia:* Set up a dialogue between industry and government to ensure sufficient governmental support for the sector. Involve academia to conduct studies and research, and fund higher education programs in offshore wind.

Actions for businesses

- *Collaborate within the supply chain:* Establish clusters and share knowledge and learnings with other players in the value chain to collaboratively advance the industry. Ensure fair and equitable distribution of profits in the supply chain and collaborate to resolve and avoid bottlenecks.
- *Commit capital:* Invest early to catalyze rapid industry development, and anticipate that investments by others will reinforce the profitability of initial investments. Consider investments at a portfolio level rather than making individual project decisions, and take confidence in the government's firm commitment to a large home market in Norway.
- *Upgrade infrastructure:* Ensure yards and other infrastructure are fit for the purpose within the floating wind industry's component and service needs. Build vessels that meet the needs for floating wind, and not only installation vessels capable of heavy lifts.
- *Capability building:* Invest in building internal expertise and contribute to competence development of the supplier industry. Sponsor research and trainee positions in academia and work with local communities to develop blue- and white-collar talent for the offshore wind industry.
- *Invest in R&D:* Allocate resources to research and development efforts for offshore wind technology to accelerate cost reductions and develop technology and solutions that can be exported. Work with the oil and gas suppliers to prepare them for using their capabilities in offshore wind. Leverage the flourishing startup community in Norway to develop new companies.

Our call to decision-makers is to be bold and act fast. Prioritize long-term climate, nature, and economic benefits over short-term public opinion. Norway is at the doorstep of a unique opportunity. We have one chance—let's take it.

Exhibit 7 | 300 GW of offshore wind shapes Norway's future

870 bn NOK export revenues p.a	150,000 direct and indirect jobs	400 Mt CO_2 equivalents avoided p.a.	1,500 TWh energy delivered p.a.
Equivalent to 90% of Norway's export revenues from oil and gas in 2021	Equivalent to 75% of direct and indirect jobs related to Norwegian oil and gas in 2022	Equivalent to 11% of EU's CO_2e emissions in 2022	Equivalent to 60% of Norway's oil and gas primary energy production in 2022

Source: BCG analysis

7 | BCG's Nordic offshore wind team

BCG is a global consulting firm and leading strategy adviser. We partner with leaders in business and society, collaborating closely to solve the most important challenges and capture the best opportunities.

In the Nordics, we have built an offshore wind hub with dedicated consultants and analysts, including offshore wind professionals with backgrounds from Equinor, Ørsted, RWE, Siemens Gamesa, and similar companies. Our local offshore wind team is supported by BCG's global network of experts, enabling us to combine global expertise with local market intelligence and understanding.

Our Nordic offshore wind team serves clients across the offshore wind value chain, including developers, suppliers, transmission system operators, regulators, and investors. We bring our local expertise abroad and deliver global expertise to the Nordics to drive client impact. Over the past few years, the Nordic offshore wind team has done close to 100 projects with companies in the offshore wind industry across the Nordics, Europe, North America, and Asia.

Our team is at the forefront of developing BCG's global intellectual property in offshore wind, and we are actively sharing insights back with the industry. We are curious individuals and always looking for a good intellectual challenge and debate. Please do not hesitate to reach out to set up a discussion with us.

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Related BCG publications

Offshore Wind: Future of Logistics

Offshore wind is growing, with each part of the supply chain maturing quickly. This study presents findings from a comprehensive survey BCG ran on logistics in the industry. Solutions across installation and operations were compared based on customer expectations, industry pain points and preferences.

Mastering Scale in Renewables

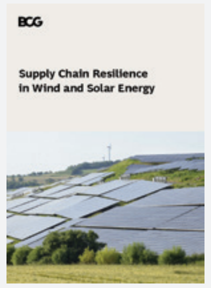
The importance of scale is key in offshore wind and other renewable energy sources. In this article, BCG assesses the impact of scale on value creation and the most important levers that can be pulled to leverage scale benefits.

Nordic Net Zero: The Green Business Opportunity

The Nordic countries all have ambitious climate targets, but struggle to meet them. Offshore wind and other renewables is fundamental to reach the targets. In this report, BCG identifies a feasible and affordable path to net zero emissions for each of the Nordic countries.

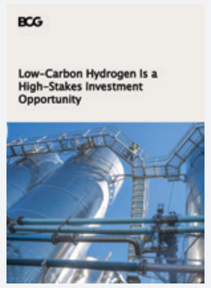
Norway's Competitiveness in the Energy Transition

The energy transition is here, but which countries have what it takes? In this joint article, BCG and NHO presents a quantitative ranking of selected countries' competitive positions in the energy transition.



Supply Chain Resilience in Wind and Solar Energy

Supply chains in offshore wind and the remaining renewable energy industry is under pressure, with resilience being top-of-mind for executives. In this article, BCG's leading experts look at solutions for supply chain and procurement challenges for renewable players.



Low-Carbon Hydrogen is a High-Stakes Investment Opportunity

The low-carbon market is still nascent, but expected to provide critical decarbonization in industries such as aviation and steel. Offshore wind and other renewables will be a key enabler. BCG has identified the actions stakeholders across the ecosystem can take to unlock the market.

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